DEVELOPMENT OF SOLAR DIGITAL CLOCK

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ABSTRACT

Solar energy is the light and radiant heat from the Sun that influence Earth's climate and weather sustains life. Solar power is synonym to solar energy or more specifically to refer the electricity generated from solar radiation. Solar energy technologies can provide electrical generation by heat engine or photovoltaic means; space heating and cooling in active and passive solar buildings, day lighting, hot water, thermal energy for cooking, and high temperature process heat for industrial purposes. Since this technology is still new in Malaysia, so the using of solar as electric source is limited. So, in this case, I need to develop a system that uses solar power as basic supply to replace supply from Tenaga Nasional Berhad (TNB).The objectives of this project are to design a charger that uses solar as source to charge the battery. To supply the required voltage to the digital clock, a voltage regulator needed to stabilize the required output voltage from the battery to supply the microcontroller then digital clock. The first step to start this project is to make a thorough analysis about the panel solar that will be used for this project. After obtaining the data needed, a charger circuit must be design to charge the battery. This will ensure that the charger which will charge the battery are functioning and will be able to supply the digital clock circuits which have function as a load. Besides that, the digital clock needs to be design and use ATMEL 89S52 as controller. This digital clock will use 4 inch seven segment as the display instead of normal LED regarding to its advantages.

ABSTRAK

Tenaga suria adalah tenaga yang terhasil daripada sinaran cahaya matahari dan ultra violet dan mempengaruhi iklim Bumi. Tenaga suria juga dirujuk sebagai tenaga yang dihasilkan daripada sinaran matahari. Teknologi tenaga suria dapat menghasilkan tenaga elektrik untuk kegunaan pemanasan, sistem penyejukan dalam bangunan, kegunaan memasak dan untuk kegunaan industri. Oleh kerana teknologi ini masih baru di Malaysia, kegunaan tenaga suria sebagai sumber tenaga elektrik adalah terhad. Oleh yang demikian, satu sistem yang menggunakan tenaga suria sebagai sumber asas untuk menggantikan sumber yang dibekalkan oleh Tenaga Nasional Berhad perlu dibangunkan. Tujuan kajian ini adalah untuk membina sebuah pengecas yang menggunakan tenaga suria sebagai sumber untuk mengecas bateri. Sebagai satu beban, sebuah jam digital akan dibina. Untuk membekalkan tenaga yang bersesuian kepada jam digital, voltage regulator diperlukan untuk menstabilkan voltan yang bersesuaian daripada bateri kepada microcontroller dan pemapar. Langkah pertama untuk memulakan projek ini adalah dengan mengadakan analisis menyeluruh mengenai panel suria yang akan digunakan dalam projek ini. Selepas maklumat yang diperlukan telah dikumpul, satu litar pengecas akan dibina untuk mengecas bateri. Ini akan memastikan bahawa pengecas ini akan mengecas bateri dan berfungsi dan berupaya untuk membekalkan tenaga kepada jam digital yang berfungsi sebagai beban. Selain itu, jam digital akan dibina dengan menggunakan ATMEL 89S52 sebagai pengawal. Jam digital ini akan menggunakan 7 segmen yang bersaiz 4 inci sebagai pemapar.

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LIST OF SYMBOLS

A	-	Ampere
Ah	-	Ampere per hours
R	-	Resistor
kWh	-	kilowatts per hours
W	-	Watts
m^2	-	meter square
m	-	mili
V	-	Voltage
u	-	micro
F	-	Farad
DC	-	Direct current

LIST OF ABBREVIATION

MOSFET	-	Metal Oxide semiconductor Field Effect Transistor
PIC	-	Peripheral Interface Controller
NiCd	-	Nickel-cadmium
NiMH	-	Nickel Metal Hydride
IC	-	Integrated Circuit

LIST OF APPENDIX

CHAPTER 1

INTRODUCTION

1.1 Overview

Nowadays, solar energy widely use in entire world. The location of Malaysia on the equator, give our country an advantages which is receive 12 hours day sunlight. In this case, we can use solar as alternative energy. Solar energy is a renewable energy which converts from solar energy to electrical energy by use solar panel or photovoltaic.

Since it just produces small output, we need to store the charge in the battery. In this case, the charger must be design to charge the battery. The charger will make sure that the energy just flow from solar panel to battery and not vice versa. In addition, a voltage regulator must be constructing to make sure that the supply voltage to the load must in stable state. As for load, digital clock will be developing by display the output using LED instead of seven segments. Previously, we suggest using PIC to run the clock and use super bright LED to display the output. But after study the circuit that we have got, we prefer to use microcontroller for digital clock which is ATMEL AT89S52. Meanwhile, super bright LED is cost effective for power consumption but is a lot of expensive to buy it. So, as the solution, we just use normal 4 inch seven segments regarding to its larges and attractive displays.

In addition, little research about the circuit must be done in case to find the suitable one to finish this project. All knowledge about what have been study before will be use in achieve this research.

Since, the solar panel cannot produces constant supply for the load, the charger need to be design to store the energy to the battery. This is because; we not receive sunlight 24 hours a day. So, the battery will supply its stored charged during nights. The charger must make sure that the charge only flow in one way which is from solar panel to the battery and not vice versa. This battery is also important because we only receive sunlight 12 hours per day and during night, it will supply the energy to the load. Furthermore, the load needs stable voltage. To solve this problem, a voltage regulator must be design. The load that we use here is digital clock which is will can be place at crowded place area UMP, for example; cafeteria or bus stop. Normally, the digital clock that we see nowadays uses 7 segments and LCD display. In this case, 4 inch will be use instead of 1inch segments and LCD.

1.2 Objective

The aim of this research is to develop a digital clock which is supply by solar energy. It will help people who need to know the time at certain place which have no power supply to run the clock. As such, the proposed project seeks to fulfill the following objectives:

i) To design battery charger to store the energy until it reach the limit.
ii) To develop a digital clock with big display.
iii) To operate the digital clock by using solar energy and battery.

1.3 Scope of Project

Through this project, there are several scopes that need to be proposed for this project:

i) Generate electrical energy (17Vdc 5A) from solar panel and then store it to battery (12Vdc 40A) by using battery charger.

ii) Get stabilized voltage for used at lower voltage devices.

iii) The clock will be developing by using microcontroller.

1.4 Problem Statement

Nowadays, many types of chargers that sell in market are compatible for indoor use such as for charging mobile phone battery, nickel-cadmium battery, and alkaline battery and so on. For solar system battery charger, it is little bit difficult to find it at the market.

As for digital clock, there is various type of digital clock we can buy at the market especially digital clock. But it is little bit difficult to find the digital clock that use DC voltage as supply. The typical digital clock that sell in market normally use AC supply.

It is difficult to use electrical appliance at the place that have no socket outlet. So, to operate the electrical appliance, a solar battery charger will be develop to store energy in an acid leak battery and then, use the stored energy to operate the electrical appliance which in this case, digital clock have been used.

Since our country located at the equator, we will receive sunlight average 5 hours per day. It will give us advantages to use the solar energy as alternative energy since this type of energy is clean and cost effective. It will save our planet.

1.5 Thesis Organization

There are all five chapters beings structures in this thesis and every chapter will elaborate in detail about this project. For the first chapter, Chapter 1, an overview about this project, Development of Solar Digital Clock is discussed including the objectives and scopes of the project as a guide to develop the solar charger and digital clock.

Chapter 2 will explain and discuss on the literature review of the solar charger and digital clock. It also focuses on general introduction of the photovoltaic and microcontroller. It gives brief review types of chargers.

Chapter 3 will discuss about methodologies of the development of solar digital clock that has been applied in completing in this project. In this chapter, it consists of block diagram and flow chart which are explained about the process of implementation and how the charger circuit charges the battery. It also discusses briefly how the output can be varied.

Chapter 4 is discussing and displaying all the result obtained and the limitation of the project. All the discussion is concentrated on the result and the overall performance of solar charger and digital clock.

Chapter 5 in overall will discuss on the conclusion and summary of the development of solar digital clock. In this chapter, the problems and recommendations for modification also will be discussed.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This thesis involved the design and research regarding on battery charger with digital clock as load. In this chapter, the researcher reviews article and past research about the component and device to get enough information regarding the project. A review of the article was performed to identify studies that relevant to the topic. A combination of the following keywords was used to identify relevant material. The Solar Digital Clock concept is integrated the solar charger, voltage regulator and microcontroller to control the clock count.

2.2 Solar Energy

Solar energy is a type of renewable energy which is widely used in entire world. It is suitable for powering outdoor [5] advertising signs. Solar panel which is also known as photovoltaic is a device that receives the energy from the sun and then converts it to electrical energy. Solar panel has several types according to their size and

output. It will produce DC voltage [6]. Its output which is 17Vdc 5A must be store to a battery. A solar battery system characterized by at least one solar cell for converting light energy to electrical energy which is store in the system provided [8]. This is needed because the solar panel cannot supply the power directly to the load. So, a charger is needed to make this process flow smoothly.

2.3 General Definition of Charger Circuit

Charger is a combination of electronic component that allow the process of transfer energy from a source to a medium. In this case, the medium that mention previously is battery. Battery is a medium that install the energy. On the other hand, battery charger is a device used to put energy into a secondary cell or rechargeable battery by forcing an electric current through it [1]. Normally, simple charger takes longer time to charge the battery compare to fast charging type.

2.4 Types of charger

2.4.1 Simple charger

A simple charger is working when a source of constant DC power supply to a battery. The simple charger does not alter its output based on time or the charge on the battery. This type of charger is not expensive, but its quality is not too good. Typically, a simple charger takes longer to charge a battery to prevent severe over-charging. Furthermore, the energy which is stored in the battery is not mortal in it.

It will discharge due to time. These chargers can supply either a constant voltage or a constant current to the battery [1].

2.4.2 Timer Based

This type of charger is terminated after a pre-determined time. If batteries of lower capacity were charged then they would be overcharged. Vice versa, if the higher capacity batteries were charged, they would be only partly charged. Timer based chargers also had the drawback that charging batteries that were not fully discharged, even it of those batteries were of the correct capacity for the particular timer charger, would result in overcharging [1].

2.4.3 Intelligent

Output current depends upon the battery's state. An intelligent charger may monitor the battery's voltage, temperature and/or time under charge to determine the optimum charge current at that instant. Charging is terminated when a combination of the voltage, temperature and/or time indicates that the battery is fully charged. A typical intelligent charger fast-charges a battery up to about 85% of its maximum capacity in less than an hour, then switches to trickle charging, which takes several hours to top off the battery to its full capacity[1].

2.4.4 Fast

Fast chargers make use of control circuitry in the batteries being charged to rapidly charge the batteries without damaging the cells' elements. Most such chargers have a cooling fan to help keep the temperature of the cells under control. Most are also capable of acting as a standard overnight charger if used with standard NiMH cells that do not have the special control circuitry. Some fast chargers, such as those made by Energizer, can fast-charge any NiMH battery even if it does not have the control circuit [1].

2.4.5 Pulse

Some chargers use pulse technology in which a pulse is fed to the battery. This DC pulse has a strictly controlled rise time, pulse width, pulse repetition rate (frequency) and amplitude. This technology is said to work with any size, voltage, capacity or chemistry of batteries, including automotive and valve-regulated batteries. With pulse charging, high instantaneous voltages can be applied without overheating the battery. In a Lead-acid battery, this breaks down stubborn lead-sulfate crystals, thus greatly extending the battery service life [1].

2.4.6 Inductive

Inductive battery chargers use electromagnetic induction to charge batteries. A charging station sends electromagnetic energy through inductive coupling to an electrical device, which stores the

energy in the batteries. This is achieved without the need for metal contacts between the charger and the battery. It is commonly used in electric toothbrushes and other devices used in bathrooms. Because there are no open electrical contacts, there is no risk of electrocution [1].

2.5 Acid Lead Battery

Figure 2.1 Acid Lead Battery

Lead-acid batteries, invented in 1859 by French physicist Gaston Planté, are the oldest type of rechargeable battery. Despite having the second lowest energy-to-weight ratio (next to the nickel-iron battery) and a correspondingly low energy-to-volume ratio, their ability to supply high surge currents means that the cells maintain a relatively large power-to-weight ratio. These features, along with their low cost, make them attractive for use in motor vehicles to provide the high current required by automobile starter motors [3].

Battery manufacturers define the end-of-life of a battery when it can no longer hold a proper charge (for example, a cell has shorted) or when the available battery capacity is 80% or less than what the battery

was rated for. The life of Lead Acid batteries is usually limited by several factors [2] such as *Cycle Life* is a measure of how many charge and discharge cycles a battery can take before its lead-plate grids/plates are expected to collapse and short out. The greater the average depth-of-discharge, the shorter the cycle life.

2.6 Microcontroller ATMEL 89S52

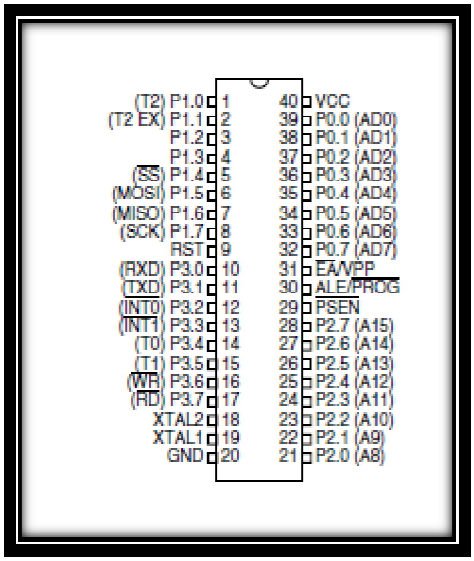

Figure 2.2 Atmel 89S52 microcontroller pin number

Figure 2.3 Microcontroller ATMEL 89S52